

# PATENT ABSTRACTS OF JAPAN

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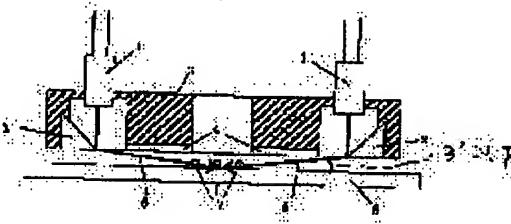
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## (54) LIGHTING SYSTEM AND GRANULAR MATTER DETECTOR

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide lighting system and a granular matter detector increasing contrast between scattered light from a spacer and reflected light from a wiring pattern for facilitating separation based on binarization between the spacer and a background.

**SOLUTION:** The lighting system is provided with a light guide 1 as a light supplying means and a mirror 2 held so as to reflect light from the light guide 1. For detecting a spacer 7 as a granular matter, this lighting system radiates light beams 5 toward a desired detection position in at least two directions which are not orthogonal to any linear part of a wiring pattern in the view from the upper side and make an angle of 3° or less with the upper face of a glass substrate 6.



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**CLAIMS**

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**[Claim(s)]**

[Claim 1] the line of the shape of a matrix prepared in the top face by intersecting perpendicularly — in order to detect the granule which exists in the detection location of the request on the top face of a substrate which has a pattern — the detection location of said request — receiving — from the upper part — seeing — said line — the lighting system which is a 2-way at least and irradiates light also to which straight-line part of a pattern by the direction of radiation from which the substrate top face and the include angle make which are not an abbreviation perpendicular become 3 degrees or less.

[Claim 2] The lighting system [ equipped with the optical supply means and the mirror held so that the light from said optical supply means might be reflected in said direction of radiation ] according to claim 1.

[Claim 3] The lighting system according to claim 2 with which said optical supply means and said mirror are held, and it has the holder which has an inferior surface of tongue, and the crevice is established in said inferior surface of tongue so that the light which advances to said direction of radiation may not be barred.

[Claim 4] The lighting system according to claim 2 or 3 which condenses the light which came out of said optical supply means, and is equipped with the lens led to said mirror.

[Claim 5] Granule detection equipment equipped with the lighting means which contains the lighting system of a publication in claims 1-4, a photodetection means to detect the reflected light from the measurement part of said request irradiated with said lighting means, and the extract means which carries out the separation extract of the information resulting from said granule from the result detected with said photodetection means.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention] This invention relates to the lighting system used for the granule detection equipment and this which conduct counting of the spacer used for forming the gap between glass substrates, such as a liquid crystal panel equipped with a thin film transistor (TFT:Thin Film Transistor) as a switching element for driving liquid crystal, an agglutination test, and dust particle inspection that detects the foreign matter on a glass substrate.

#### [0002]

[Description of the Prior Art] (Production process of a liquid crystal panel) A liquid crystal panel is equipped with the electrode for driving liquid crystal, and is equipped with the liquid crystal layer formed between the glass substrates and the glass substrates of a pair of the pair arranged in parallel at fixed spacing. This liquid crystal panel is manufactured by the approach as shown below.

[0003] The sealing compound of a heat-curing mold is applied to one glass substrate among the glass substrates of a pair, and the spacer for making substrate spacing the glass substrate of another side at homogeneity is sprinkled. As for a spacer here, the uniform plastics bead of a spherical diameter is usually used. Then, alignment of the glass substrate of this pair is performed and eye tacking is performed.

[0004] This glass substrate is pressed and it is made for substrate spacing to become the same as the diameter of a spacer. A sealing compound is stiffened by heating and lamination is performed. The stuck substrate is cut in the magnitude of a desired liquid crystal panel. Liquid crystal is poured in into a vacuum chamber in the gap between glass substrates. UV irradiation of the encapsulant of an ultraviolet curing mold is applied and carried out to an inlet after liquid crystal impregnation termination, and the closure of impregnation RO is performed.

[0005] By the above approach, the liquid crystal panel filled up with the gap between the glass substrates of a pair with liquid crystal can be manufactured.

[0006] (Spacer) The number and distributing the spacer arranged in the production process of an above-mentioned liquid crystal panel in order to form the gap between the glass substrates of a liquid crystal panel in homogeneity become important. [ which are sprinkled ] If there are too few spacers, the gap between glass substrates will become narrow, and a predetermined gap cannot be formed, but display grace will deteriorate. Moreover, if there are too many spacers, the so-called optical omission in the spacer circumference will increase. When the liquid crystal of the spacer circumference causes orientation turbulence, saying "keep shining", or a spacer is transparent and the spacer itself penetrates light, and it is going to indicate by black by intercepting light, the phenomenon in which light penetrates only the part and it does not become a black display correctly is said. Generating of such an optical omission brings about the fall of contrast, and display grace deteriorates.

[0007] For this reason, it is necessary to measure the number of a spacer, and distribution, after sprinkling a spacer, and to supervise the spraying condition of a spacer. The following approaches are used as an approach of performing counting of a spacer. With the reflected illumination using the ring light 41 as shown in drawing 6, the illumination light is applied to a

spacer and the scattered light is generated from a spacer. The scattered light from a spacer is incorporated using a CCD camera. A spacer and a background are separated by performing binary-ization to the captured image, and counting of a spacer is performed.

[0008] When the glass substrate with which the spacer is sprinkled is a glass substrate in which TFT was formed, circuit patterns, such as a gate line and a source line, are formed of metal membranes which have a high reflection factor, such as Ta and aluminum. When the irregularity of a circuit pattern is large, with the lighting in a ring light, the edge of a circuit pattern also generates the reflected light. For this reason, separation by binary-izing with the circuit pattern and spacer which were formed in the glass substrate becomes difficult.

[0009] On the other hand, in JP,8-148025,A, in order to reduce the reflected light from the circuit pattern formed in the glass substrate, in the structure shown in drawing 6, the technique of shading the part which it intersects perpendicularly to the circuit pattern of a gate line and a source line among the lighting parts of a ring light, and is irradiated is proposed. Thereby, the reflected light from a circuit pattern can be reduced and separation by binary-izing with a spacer and a background becomes easy.

[0010]

[Problem(s) to be Solved by the Invention] With the technique proposed in this official report, in case counting of a spacer is performed, counting in the measurement part of arbitration is performed, moving the substrate which is the measuring object. For the implementation, in the lighting system proposed in this official report, only the path clearance of extent which does not contact a glass substrate 6 even if it moves a glass substrate 6 floats, and the ring light 41 is installed.

[0011] At this time, the optical fiber floodlighting opening 42 of the ring light 41 shown in drawing 6 is arranged rather than the base of the ring light 41 in the location on some. When a plate 43 is made not much thin, it becomes impossible to maintain the reinforcement of the ring light 41, although it is desirable to make it as thin as possible as for a plate 43 in order to bring light close from the optical fiber floodlighting opening 42 as horizontally as possible when the part below the optical fiber floodlighting opening 42 is calling it a plate 43. However, if a plate 43 is thickened, incidence of the light will be carried out from the slanting upper part from the optical fiber floodlighting opening 42 to a measurement part. <BR> [0012] Therefore, when the irregularity of the circuit pattern in a measurement part is large, the exposure light from the non-shading part of a ring light makes the reflected light of the sense which faces to an upper CCD camera generated so much in the part irradiated by the abbreviation perpendicular to a circuit pattern part.

[0013] Or although it is also possible to bring the incidence of the light to a measurement part close horizontally by enlarging the diameter of the ring light 41 even if a plate 43 is somewhat thick, the distance from the optical fiber floodlighting opening 42 to a measurement part will become long in that case, and an illuminance will fall.

[0014] Although the reflected light in the circuit pattern of a gate line and a source line is reduced, since the exposure light from the part which a ring light does not shade may generate the reflected light after all in the part irradiated at right angles to a circuit pattern according to this lighting system, there was a trouble that separation by binary-izing with a spacer and a background became difficult.

[0015] This invention aims at offering the lighting system and granule detection equipment which make easy separation by binary-izing with a spacer and a background by being made in order to solve an above-mentioned technical problem, reducing the reflected light from the circuit pattern formed in the glass substrate of a liquid crystal panel, and enlarging contrast of the scattered light from a spacer, and the reflected light from a circuit pattern.

[0016]

[Means for Solving the Problem] In the lighting system based on [ in order to attain the above-mentioned purpose ] this invention the line of the shape of a matrix prepared in the top face by intersecting perpendicularly, in order to detect the granule which exists in the detection location of the request on the top face of a substrate which has a pattern the detection location of the above-mentioned request — receiving — from the upper part — seeing — the above — a line —

— also to which straight-line part of a pattern, it is a 2-way at least and light is irradiated by the direction of radiation from which the substrate top face and the include angle to make which are not an abbreviation perpendicular become 3 degrees or less. adopting this configuration — a line — since the include angle which it sees from the upper part, and light does not irradiate an abbreviation perpendicular to the straight-line part of each component of a pattern, and is made with a substrate top face is 3 degrees or less from which the good result was obtained also by experiment, the reflected light which goes upwards from the edge of each of these components etc. can be reduced.

[0017] In the above-mentioned invention, it has preferably an optical supply means and the mirror held so that the light from the above-mentioned optical supply means might be reflected in the above-mentioned direction of radiation. It becomes possible to irradiate light with illuminance sufficient by the direction of radiation from which the include angle which a substrate can be made to reflect in the location which approached extremely, consequently is made with a substrate top face becomes 3 degrees or less since it is possible to make it reflect by adopting this configuration in the lower limit of a mirror certainly and easily.

[0018] In the above-mentioned invention, preferably, the above-mentioned optical supply means and the above-mentioned mirror are held, and it has the holder which has an inferior surface of tongue, and the crevice is established in the above-mentioned inferior surface of tongue so that the light which advances to the above-mentioned direction of radiation may not be barred.

[0019] By adopting the above-mentioned configuration, the physical relationship of an optical supply means and a mirror is more certainly fixed by existence of a holder, and the handling of a lighting system becomes easy by it. Moreover, without being barred on the inferior surface of tongue of a holder, if it is fixed within the limits even if the light reflected from the mirror diffuses or a travelling direction shifts, since a crevice is located on the inferior surface of tongue of a holder, it can arrive at a measurement part and can irradiate with sufficient illuminance. Furthermore, the role which intercepts the light which goes by the direction of radiation to which the include angle to make becomes larger than a desired include angle with a substrate top face can also be given to a measurement part by not making the depth of a crevice deep more than fixed.

[0020] In the above-mentioned invention, preferably, the light which came out of the above-mentioned optical supply means is condensed, and it has the lens led to the above-mentioned mirror. By adopting this configuration, the light supplied from the optical supply means can be efficiently reflected by the mirror. Moreover, since the condensed light reflects and it goes to a measurement part, the illuminance of a measurement part can be raised.

[0021] In the granule detection equipment based on this invention, it has the lighting means containing an above-mentioned lighting system, a photodetection means to detect the reflected light from the measurement part of the above-mentioned request irradiated with the above-mentioned lighting means, and the extract means that carries out the separation extract of the information resulting from the above-mentioned granule from the result detected with the above-mentioned photodetection means.

[0022] the line among the light irradiated by adopting the above-mentioned configuration — since the light scattered about by the granule tends toward a photodetection means while the component which reflects by the pattern and tends toward a photodetection means decreases, contrast with the image of the figure and ground of a granule is large, and the image which detected with a photodetection means becomes easy [ separating what makes it binary and originates in a granule, and the thing resulting from a background ]. Furthermore, since this granule detection equipment is equipped with the extract means, it is easily highly precise and can perform counting of a granule, and distribution grasp.

[0023]

[Embodiment of the Invention] (Gestalt 1 of operation)

(Configuration) The lighting system in the gestalt of this operation is shown in drawing 1 . This lighting system is equipped with the holder 3 holding the light guide 1 which is an optical supply means to irradiate the light from the light source (illustration abbreviation), the mirror 2 which reflects the exposure light from a light guide 1 to a glass substrate 6, and a light guide 1 and a

mirror 2. When putting the glass substrate 6 which is the measuring object on a horizontal plane and measuring by installing this lighting system above a glass substrate 6, the light guide 1 is being fixed so that outgoing radiation of the light may be carried out towards a vertical lower part from the vertical upper part, and the mirror 2 is being fixed to the holder 3 so that the horizontal plane of that reflector and the include angle to make may become 46 degrees. As shown in drawing 2, when a mirror 2 reflects the light irradiated from the light guide 1 of the vertical upper part, what was carried out in this way although the reflector of a mirror 2 made 46 degrees the horizontal plane and the include angle to make here is the direction of radiation from which the include angle which the reflected light makes between horizontal planes becomes 2 degrees, and is for making it go to a measurement part. When a holder 3 is the structure where it does not have an inferior surface of tongue, there is no possibility that the inferior surface of tongue of a holder 3 may bar advance of light, but in order to maintain reinforcement, as for a holder 3, it is desirable to be able to consider the case where it is the structure of having an inferior surface of tongue, and to establish the crevice in the inferior surface of tongue in that case, so that the light which advances toward a measurement part may not be barred. In the structure of drawing 1, the slot 4 is formed as such a crevice. In addition, the role which intercepts the light which goes by the direction of radiation to which the include angle to make becomes larger than a desired include angle with a substrate top face can also be given to a measurement part by not making the depth of a slot 4 deep more than fixed.

[0024] The place which looked at the condition that this lighting system performed measurement about a glass substrate 6 to drawing 3, from the upper part is shown. the line of the shape of a matrix established by the top face and a glass substrate 6 crossing at right angles — it has as a pattern the circuit pattern with which the gate line 11 and the source line 12 intersect perpendicularly, and has the TFT component 13 in the corner of each partition divided in the shape of [ the ] a matrix. It explains hereafter by making the center of the transparent electrode 14 in each partition into a measurement part.

[0025] if it observes about the direction of radiation of the light to a measurement part with reference to drawing 3 — light — a line — the light guide 1, the mirror 2, and the slot 4 are arranged so that it may irradiate as a light 5 from four directions where the direction rotated about 45 degrees from the direction of a pattern intersects perpendicularly.

[0026] (An operation and effectiveness) It reflects by the mirror 2, and the light irradiated from the light guide 1 passes through a slot 4, and goes to a measurement part as a light 5. From four directions where a \*\*\*\* intersects perpendicularly, light 5 is the direction of radiation from which glass substrate 6 top face (horizontal plane) and the include angle to make become 2 degrees, and is irradiated. Light 5 is scattered about in a spacer 7. If a certain photodetection means is installed above this lighting system, the scattered light from a spacer 7 can be detected and it can use as information for inspection.

[0027] The light detected when the reflected light resulting from the circuit pattern formed in the glass substrate 6 since the include angle with the top face of the glass substrate 6 of light 5 to make was as small as 2 degrees can stop the component reflected up few on the other hand and the photodetection means has been arranged up can become dominant [ the scattered light resulting from a spacer 7 ].

[0028] Since it irradiates from the direction which looked at from the upper part and was rotated about 45 degrees also to which straight-line parts of the gate line 11 and the source line 12, the light 5 from four directions can reduce the component which light does not irradiate straight-line parts, such as the gate line 11, the source line 12, and the TFT component 13, at an abbreviation perpendicular, and goes up by the reflected light from edges, such as these circuit patterns, etc.

[0029] (Gestalt 2 of operation)

(Configuration) The lighting system in the gestalt of this operation is shown in drawing 4. Although it is the same as what was explained with the gestalt 1 of operation (refer to drawing 1 and drawing 3) fundamentally, the light which came out of the light guide 21 as an optical supply means is condensed, and it has a condenser lens 26 as a lens for leading to a mirror 22. The condenser lens 26 is held with the light guide 21 at the condensing lens holder 27.

[0030] (An operation and effectiveness) The light supplied from the light guide 21 by forming a

condenser lens 26 in this way can be efficiently reflected by the mirror 22. Moreover, since the condensed light reflects and it goes to a measurement part as a light 25, the illuminance of a measurement part can be raised.

[0031] In addition, although it was made for the include angle which the reflector of a mirror 2 makes 46 degrees a horizontal plane and the include angle to make, and the reflected light makes between horizontal planes to become 2 degrees with the gestalt of each above-mentioned implementation, these combination may be values other than these. although it increased so that separation of a spacer and a circuit pattern was difficult for the reflected light from the circuit pattern detected when the include angle which the reflected light makes between horizontal planes when experimented by changing some kinds of include angles is large 3 degrees and the photodetection means has been arranged up by binary[ of an image ]-izing, \*\* it makes it become 3 degrees or less, the reflected light from a circuit pattern could be \*\*\*\*ed remarkably few, and dissociating became easy — \*\*. Therefore, as for the include angle which the reflected light makes between horizontal planes, it is desirable that it is 3 degrees or less.

[0032] It is because the light which shines upon a circuit pattern although light shines upon a spacer when, as for a circuit pattern, the height from a substrate side puts light in a near include angle more than fixed horizontally compared with a spacer to appearing in the form which this [ a spacer's ] is large on a substrate side, and projects, since it is low, and scattered about becomes remarkably small.

[0033] In addition, although there was a publication of the purport which irradiates "almost horizontally" also with the technique indicated by JP,8-148025,A, in the lighting system indicated by this official report, optical fiber floodlighting opening needed to be prepared near the substrate, and the include angle of the direction of radiation and a horizontal plane to make had become an actually bigger value than 3 degrees from constraint that the reinforcement of the ring light itself must also be maintained with the plate of the optical fiber floodlighting opening bottom. That is, "it is horizontally mostly" was only the direction of radiation near comparatively horizontally substantially chosen in the bigger include angle than 3 degrees. On the other hand, on the other hand, the lighting system in which an exposure in a direction 3 degrees or less is actually possible is offered for the case of this invention where it is 3 degrees or less by experiment being especially desirable a header and by canceling the above-mentioned constraint.

[0034] in addition — the gestalt of each above-mentioned implementation — from the upper part — seeing — light — a line, although it constituted so that it might irradiate from four directions where the direction rotated about 45 degrees from the direction of a pattern intersects perpendicularly that by which this angle of rotation is restricted to about 45 degrees — it is not — a line — the line when seeing from a top also to which straight-line part of a pattern, when it was the direction which is not an abbreviation perpendicular — about the include angle to a pattern, you may be the exposure from other include angles. Moreover, it may be [ rather than it may be indispensable ] the exposure from a 2-way that it is the exposure from four directions which intersect perpendicularly at least, although it is desirable especially in order to raise the illuminance of a measurement part, to prepare the balance of the sense of dispersion in a spacer and to increase the scattered light from a spacer.

[0035] (Gestalt 3 of operation)

(Configuration) The granule detection equipment in the gestalt of this operation is shown in drawing 5 . This granule detection equipment is for detecting the granule which exists in the detection location of the request on the top face of a substrate, and is equipped with the lighting system 32 stated to the gestalten 1 or 2 of operation as a lighting means. Furthermore, this granule detection equipment is equipped with CCD camera 34 as a photodetection means to detect the reflected light from the desired measurement part irradiated with the lighting system 32. Furthermore, it is equipped with an image processing system 35 from the result detected with CCD camera 34, using this granule detection equipment as the extract means which carries out the separation extract of the information resulting from a granule.

[0036] The light guide 31 of a lighting system 32 has received supply of light from light equipment 33. Even if a light guide 31 is the case where there are more than one, it can provide

branching connection by one set of light equipment 33. Although a halogen lamp can be used for light equipment 33, it is not restricted to this but should just emit the same light. Only fixed path clearance floats from a glass substrate 6, and the lighting system 32 is held so that it may not contact, even if it moves the glass substrate 6 with which the spacer 7 was sprinkled.

[0037] (An operation and effectiveness) Detection of a spacer is performed by the procedure described below. A glass substrate 6 is moved so that the measurement part of a request of the glass substrate 6 with which the spacer 7 was sprinkled may come just under CCD camera 34. A lighting system 32 performs the exposure to a measurement part.

[0038] To a circuit pattern, the exposure light from a lighting system 32 is the direction of radiation to which glass substrate 6 top face (horizontal plane) and the include angle to make become 2 degrees from four directions which were stated with the gestalt 1 of operation, and which intersect perpendicularly, and is irradiated. Consequently, although the irradiated light is scattered about in a spacer 7 as the gestalt 1 of operation described, the component reflected toward CCD camera 34 upper by the reflected light from edges, such as a circuit pattern, etc. can be reduced. That is, as a light detected by CCD camera 34, the scattered light from a spacer 7 becomes dominant. Therefore, in case the image captured with CCD camera 34 is processed with an image processing system 35, contrast with the image of the figure and ground of a spacer 7 is large, and it becomes easy to separate what makes it binary and originates in a spacer 7, and the thing resulting from a background. Consequently, the detection precision of a spacer can go up and counting of a spacer and distribution grasp can be performed now with high precision.

[0039] In addition, although it came by the gestalt of each above-mentioned implementation considering the spacer as a candidate for detection, it is good also considering condensation of a spacer as a candidate for detection, and good also considering foreign matters, such as a contaminant on a glass substrate, and dust, as a candidate for detection. That is, it can also use for detection of granules other than a spacer.

[0040] In addition, the gestalt of the above-mentioned implementation indicated this time is [ no ] instantiation at points, and restrictive. The range of this invention is not the above-mentioned explanation, is shown by the claim, and includes all modification in a claim, equal semantics, and within the limits.

[0041]

[Effect of the [Invention]] since light is irradiated by the direction of radiation from which a substrate top face and the include angle to make become 3 degrees or less by reflecting light by the mirror according to this invention — a line — the reflected light to the upper part [ pattern ] can be reduced. Therefore, as for the image detected with the photodetection means established up, contrast with the image of the figure and ground of a granule becomes large. Therefore, it becomes easy to separate what makes it binary and originates in a granule, and the thing resulting from a background.

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**TECHNICAL FIELD**

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**[Field of the Invention]** This invention relates to the lighting system used for the granule detection equipment and this which conduct counting of the spacer used for forming the gap between glass substrates, such as a liquid crystal panel equipped with a thin film transistor (TFT:Thin Film Transistor) as a switching element for driving liquid crystal, an agglutination test, and dust particle inspection that detects the foreign matter on a glass substrate.

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## PRIOR ART

[Description of the Prior Art] (Production process of a liquid crystal panel) A liquid crystal panel is equipped with the electrode for driving liquid crystal, and is equipped with the liquid crystal layer formed between the glass substrates and the glass substrates of a pair of the pair arranged in parallel at fixed spacing. This liquid crystal panel is manufactured by the approach as shown below.

[0003] The sealing compound of a heat-curing mold is applied to one glass substrate among the glass substrates of a pair, and the spacer for making substrate spacing the glass substrate of another side at homogeneity is sprinkled. As for a spacer here, the uniform plastics bead of a spherical diameter is usually used. Then, alignment of the glass substrate of this pair is performed and eye tacking is performed.

[0004] This glass substrate is pressed and it is made for substrate spacing to become the same as the diameter of a spacer. A sealing compound is stiffened by heating and lamination is performed. The stuck substrate is cut in the magnitude of a desired liquid crystal panel. Liquid crystal is poured in into a vacuum chamber in the gap between glass substrates. UV irradiation of the encapsulant of an ultraviolet curing mold is applied and carried out to an inlet after liquid crystal impregnation termination, and the closure of impregnation RO is performed.

[0005] By the above approach, the liquid crystal panel filled up with the gap between the glass substrates of a pair with liquid crystal can be manufactured.

[0006] (Spacer) The number and distributing the spacer arranged in the production process of an above-mentioned liquid crystal panel in order to form the gap between the glass substrates of a liquid crystal panel in homogeneity become important. [ which are sprinkled ] If there are too few spacers, the gap between glass substrates will become narrow, and a predetermined gap cannot be formed, but display grace will deteriorate. Moreover, if there are too many spacers, the so-called optical omission in the spacer circumference will increase. When the liquid crystal of the spacer circumference causes orientation turbulence, saying "keep shining", or a spacer is transparent and the spacer itself penetrates light, and it is going to indicate by black by intercepting light, the phenomenon in which light penetrates only the part and it does not become a black display correctly is said. Generating of such an optical omission brings about the fall of contrast, and display grace deteriorates.

[0007] For this reason, it is necessary to measure the number of a spacer, and distribution, after sprinkling a spacer, and to supervise the spraying condition of a spacer. The following approaches are used as an approach of performing counting of a spacer. With the reflected illumination using the ring light 41 as shown in drawing 6, the illumination light is applied to a spacer and the scattered light is generated from a spacer. The scattered light from a spacer is incorporated using a CCD camera. A spacer and a background are separated by performing binary-ization to the captured image, and counting of a spacer is performed.

[0008] When the glass substrate with which the spacer is sprinkled is a glass substrate in which TFT was formed, circuit patterns, such as a gate line and a source line, are formed of metal membranes which have a high reflection factor, such as Ta and aluminum. When the irregularity of a circuit pattern is large, with the lighting in a ring light, the edge of a circuit pattern also generates the reflected light. For this reason, separation by binary-izing with the circuit pattern

and spacer which were formed in the glass substrate becomes difficult.

[0009] On the other hand, in JP,8-148025,A, in order to reduce the reflected light from the circuit pattern formed in the glass substrate, in the structure shown in drawing 6 , the technique of shading the part which it intersects perpendicularly to the circuit pattern of a gate line and a source line among the lighting parts of a ring light, and is irradiated is proposed. Thereby, the reflected light from a circuit pattern can be reduced and separation by binary-izing with a spacer and a background becomes easy.

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## EFFECT OF THE INVENTION

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(An operation and effectiveness) It reflects by the mirror 2, and the light irradiated from the light guide 1 passes through a slot 4, and goes to a measurement part as a light 5. From four directions where a \*\*\* intersects perpendicularly, light 5 is the direction of radiation from which glass substrate 6 top face (horizontal plane) and the include angle to make become 2 degrees, and is irradiated. Light 5 is scattered about in a spacer 7. If a certain photodetection means is installed above this lighting system, the scattered light from a spacer 7 can be detected and it can use as information for inspection.

[0027] The light detected when the reflected light resulting from the circuit pattern formed in the glass substrate 6 since the include angle with the top face of the glass substrate 6 of light 5 to make was as small as 2 degrees can stop the component reflected up few on the other hand and the photodetection means has been arranged up can become dominant [ the scattered light resulting from a spacer 7 ].

[0028] Since it irradiates from the direction which looked at from the upper part and was rotated about 45 degrees also to which straight-line parts of the gate line 11 and the source line 12, the light 5 from four directions can reduce the component which light does not irradiate straight-line parts, such as the gate line 11, the source line 12, and the TFT component 13, at an abbreviation perpendicular, and goes up by the reflected light from edges, such as these circuit patterns, etc.

[0029] (Gestalt 2 of operation)

(Configuration) The lighting system in the gestalt of this operation is shown in drawing 4.

Although it is the same as what was explained with the gestalt 1 of operation (refer to drawing 1 and drawing 3 ) fundamentally, the light which came out of the light guide 21 as an optical supply means is condensed, and it has a condenser lens 26 as a lens for leading to a mirror 22. The condenser lens 26 is held with the light guide 21 at the condensing lens holder 27.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] With the technique proposed in this official report, in case counting of a spacer is performed, counting in the measurement part of arbitration is performed, moving the substrate which is the measuring object. For the implementation, in the lighting system proposed in this official report, only the path clearance of extent which does not contact a glass substrate 6 even if it moves a glass substrate 6 floats, and the ring light 41 is installed.

[0011] At this time, the optical fiber floodlighting opening 42 of the ring light 41 shown in drawing 6 is arranged rather than the base of the ring light 41 in the location on some. When a plate 43 is made not much thin, it becomes impossible to maintain the reinforcement of the ring light 41, although it is desirable to make it as thin as possible as for a plate 43 in order to bring light close from the optical fiber floodlighting opening 42 as horizontally as possible when the part below the optical fiber floodlighting opening 42 is calling it a plate 43. However, if a plate 43 is thickened, incidence of the light will be carried out from the slanting upper part from the optical fiber floodlighting opening 42 to a measurement part.

[0012] Therefore, when the irregularity of the circuit pattern in a measurement part is large, the exposure light from the non-shading part of a ring light makes the reflected light of the sense which faces to an upper CCD camera generated so much in the part irradiated by the abbreviation perpendicular to a circuit pattern part.

[0013] Or although it is also possible to bring the incidence of the light to a measurement part close horizontally by enlarging the diameter of the ring light 41 even if a plate 43 is somewhat thick, the distance from the optical fiber floodlighting opening 42 to a measurement part will become long in that case, and an illuminance will fall.

[0014] Although the reflected light in the circuit pattern of a gate line and a source line is reduced, since the exposure light from the part which a ring light does not shade may generate the reflected light after all in the part irradiated at right angles to a circuit pattern according to this lighting system, there was a trouble that separation by binary-izing with a spacer and a background became difficult.

[0015] This invention aims at offering the lighting system and granule detection equipment which make easy separation by binary-izing with a spacer and a background by being made in order to solve an above-mentioned technical problem, reducing the reflected light from the circuit pattern formed in the glass substrate of a liquid crystal panel, and enlarging contrast of the scattered light from a spacer, and the reflected light from a circuit pattern.

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[Translation done.]

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## MEANS

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**[Means for Solving the Problem]** In the lighting system based on [ in order to attain the above-mentioned purpose ] this invention the line of the shape of a matrix prepared in the top face by intersecting perpendicularly, in order to detect the granule which exists in the detection location of the request on the top face of a substrate which has a pattern the detection location of the above-mentioned request — receiving — from the upper part — seeing — the above — a line — also to which straight-line part of a pattern, it is a 2-way at least and light is irradiated by the direction of radiation from which the substrate top face and the include angle to make which are not an abbreviation perpendicular become 3 degrees or less. adopting this configuration — a line — since the include angle which it sees from the upper part, and light does not irradiate an abbreviation perpendicular to the straight-line part of each component of a pattern, and is made with a substrate top face is 3 degrees or less from which the good result was obtained also by experiment, the reflected light which goes upwards from the edge of each of these components etc. can be reduced.

**[0017]** In the above-mentioned invention, it has preferably an optical supply means and the mirror held so that the light from the above-mentioned optical supply means might be reflected in the above-mentioned direction of radiation. It becomes possible to irradiate light with illuminance sufficient by the direction of radiation from which the include angle which a substrate can be made to reflect in the location which approached extremely, consequently is made with a substrate top face becomes 3 degrees or less since it is possible to make it reflect by adopting this configuration in the lower limit of a mirror certainly and easily.

**[0018]** In the above-mentioned invention, preferably, the above-mentioned optical supply means and the above-mentioned mirror are held, and it has the holder which has an inferior surface of tongue, and the crevice is established in the above-mentioned inferior surface of tongue so that the light which advances to the above-mentioned direction of radiation may not be barred.

**[0019]** By adopting the above-mentioned configuration, the physical relationship of an optical supply means and a mirror is more certainly fixed by existence of a holder, and the handling of a lighting system becomes easy by it. Moreover, without being barred on the inferior surface of tongue of a holder, if it is fixed within the limits even if the light reflected from the mirror diffuses or a travelling direction shifts, since a crevice is located on the inferior surface of tongue of a holder, it can arrive at a measurement part and can irradiate with sufficient illuminance. Furthermore, the role which intercepts the light which goes by the direction of radiation to which the include angle to make becomes larger than a desired include angle with a substrate top face can also be given to a measurement part by not making the depth of a crevice deep more than fixed.

**[0020]** In the above-mentioned invention, preferably, the light which came out of the above-mentioned optical supply means is condensed, and it has the lens led to the above-mentioned mirror. By adopting this configuration, the light supplied from the optical supply means can be efficiently reflected by the mirror. Moreover, since the condensed light reflects and it goes to a measurement part, the illuminance of a measurement part can be raised.

**[0021]** In the granule detection equipment based on this invention, it has the lighting means containing an above-mentioned lighting system, a photodetection means to detect the reflected

light from the measurement part of the above-mentioned request irradiated with the above-mentioned lighting means, and the extract means that carries out the separation extract of the information resulting from the above-mentioned granule from the result detected with the above-mentioned photodetection means.

[0022] the line among the light irradiated by adopting the above-mentioned configuration — since the light scattered about by the granule tends toward a photodetection means while the component which reflects by the pattern and tends toward a photodetection means decreases, contrast with the image of the figure and ground of a granule is large, and the image which detected with a photodetection means becomes easy [ separating what makes it binary and originates in a granule, and the thing resulting from a background ]. Furthermore, since this granule detection equipment is equipped with the extract means, it is easily highly precise and can perform counting of a granule, and distribution grasp.

[0023]

[Embodiment of the Invention] (Gestalt 1 of operation)

(Configuration) The lighting system in the gestalt of this operation is shown in drawing 1 . This lighting system is equipped with the holder 3 holding the light guide 1 which is an optical supply means to irradiate the light from the light source (illustration abbreviation), the mirror 2 which reflects the exposure light from a light guide 1 to a glass substrate 6, and a light guide 1 and a mirror 2. When putting the glass substrate 6 which is the measuring object on a horizontal plane and measuring by installing this lighting system above a glass substrate 6, the light guide 1 is being fixed so that outgoing radiation of the light may be carried out towards a vertical lower part from the vertical upper part, and the mirror 2 is being fixed to the holder 3 so that the horizontal plane of that reflector and the include angle to make may become 46 degrees. As shown in drawing 2 , when a mirror 2 reflects the light irradiated from the light guide 1 of the vertical upper part, what was carried out in this way although the reflector of a mirror 2 made 46 degrees the horizontal plane and the include angle to make here is the direction of radiation from which the include angle which the reflected light makes between horizontal planes becomes 2 degrees, and is for making it go to a measurement part. When a holder 3 is the structure where it does not have an inferior surface of tongue, there is no possibility that the inferior surface of tongue of a holder 3 may bar advance of light, but in order to maintain reinforcement, as for a holder 3, it is desirable to be able to consider the case where it is the structure of having an inferior surface of tongue, and to establish the crevice in the inferior surface of tongue in that case, so that the light which advances toward a measurement part may not be barred. In the structure of drawing 1 , the slot 4 is formed as such a crevice. In addition, the role which intercepts the light which goes by the direction of radiation to which the include angle to make becomes larger than a desired include angle with a substrate top face can also be given to a measurement part by not making the depth of a slot 4 deep more than fixed.

[0024] The place which looked at the condition that this lighting system performed measurement about a glass substrate 6 to <A HREF="/Tokujitu/tjitemdrw.ipdl?N0000=239&N0500=1E\_N/; <:=?7;///&N0001=225&N0552=9&N0553=000005" TARGET="tjitemdrw">> drawing 3, from the upper part is shown. the line of the shape of a matrix established by the top face and a glass substrate 6 crossing at right angles — it has as a pattern the circuit pattern with which the gate line 11 and the source line 12 intersect perpendicularly, and has the TFT component 13 in the corner of each partition divided in the shape of [ the ] a matrix. It explains hereafter by making the center of the transparent electrode 14 in each partition into a measurement part.

[0025] if it observes about the direction of radiation of the light to a measurement part with reference to drawing 3 — light — a line — the light guide 1, the mirror 2, and the slot 4 are arranged so that it may irradiate as a light 5 from four directions where the direction rotated about 45 degrees from the direction of a pattern intersects perpendicularly.

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[Translation done.]

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

**[Drawing 1]** It is the sectional view of the lighting system in the gestalt 1 of operation based on this invention.

**[Drawing 2]** It is an explanatory view about the optical path in the gestalt 1 of operation based on this invention.

**[Drawing 3]** It is the top view of the lighting system in the gestalt 1 of operation based on this invention.

**[Drawing 4]** It is the sectional view of the lighting system in the gestalt 2 of operation based on this invention.

**[Drawing 5]** It is the side elevation of the granule detection equipment in the gestalt 3 of operation based on this invention.

**[Drawing 6]** It is the perspective view of a lighting system based on the conventional technique.

**[Description of Notations]**

1, 21, 31 2 A light guide, 22 3 A mirror, 23 Holder, 4 24 5 A slot, 25 Light, 6 A glass substrate, 7 Spacer, 11 A gate line, 12 A source line, 13 TFT component, 14 A transparent electrode, 26 A condenser lens, 27 A condensing lens holder, 32 A lighting system, 33 Light equipment, 34 A CCD camera, 35 An image processing system, 41 A ring light, 42 Optical fiber floodlighting opening, 43 Plate.

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**[Translation done.]**

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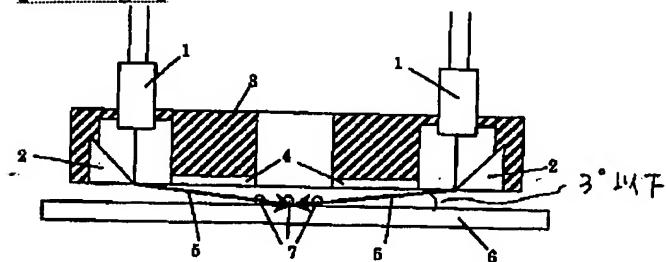
3. In the drawings, any words are not translated.

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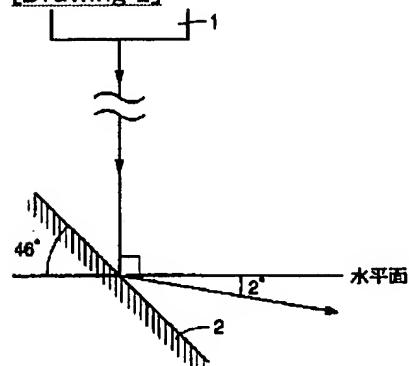
DRAWINGS

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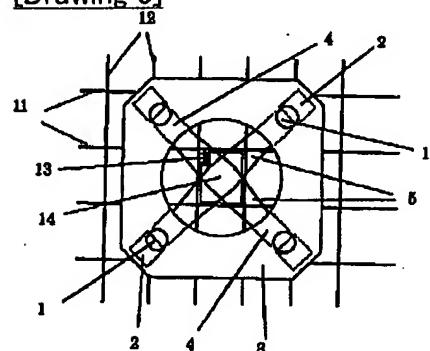
[Drawing 1]



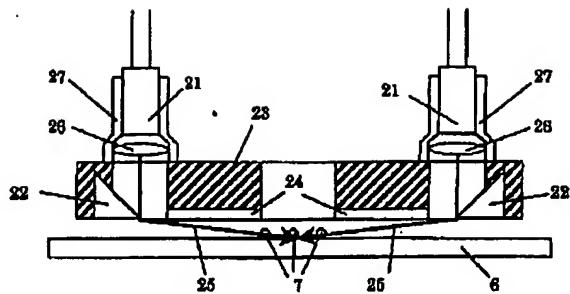
[Drawing 2]



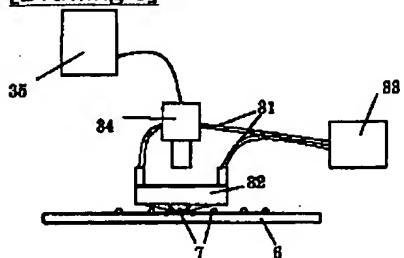
[Drawing 3]



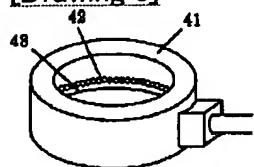
[Drawing 4]



### [Drawing 5]



**[Drawing 6]**



[Translation done.]

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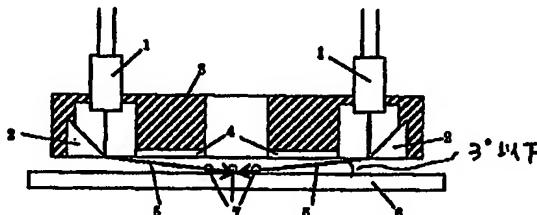
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 NA17 NA60 PA01 QA09 QA14  
 RA05 TA09

(54)【発明の名称】 照明装置および粒状体検出装置

## (57)【要約】

【課題】 スペーサからの散乱光と、配線パターンからの反射光とのコントラストを大きくすることによって、スペーサと背景との2値化による分離を容易にする、照明装置および粒状体検出装置を提供する。

【解決手段】 光供給手段としてのライトガイド1と、ライトガイド1からの光を反射するように保持されたミラー2とを備える。この照明装置は、粒状体としてのスペーサ7を検出するために、所望の検出位置に対して、上方から見て配線パターンのいずれの直線部分に対しても略垂直でない少なくとも2方向であって、ガラス基板6の上面となす角度が3°以下となるような照射方向で、光5を照射する。



## 【特許請求の範囲】

【請求項1】 上面に直交して設けられたマトリックス状の線状パターンを有する基板上面の所望の検出位置に存在する粒状体の検出を行なうために、前記所望の検出位置に対して、上方から見て前記線状パターンのいずれの直線部分に対しても略垂直でない少なくとも2方向であって、基板上面となす角度が3°以下となるような照射方向で、光を照射する、照明装置。

【請求項2】 光供給手段と、前記光供給手段からの光を前記照射方向に反射するように保持されたミラーとを備えた、請求項1に記載の照明装置。

【請求項3】 前記光供給手段および前記ミラーを保持し、下面を有するホルダを備え、前記下面には、前記照射方向に進行する光を妨げないように凹部が設けられている、請求項2に記載の照明装置。

【請求項4】 前記光供給手段から出た光を集光し、前記ミラーに導くレンズを備える、請求項2または3に記載の照明装置。

【請求項5】 請求項1から4に記載の照明装置を含む照明手段と、前記照明手段で照射した前記所望の測定箇所からの反射光を検出する光検出手段と、前記光検出手段で検出した結果から、前記粒状体に起因する情報を分離抽出する抽出手段とを備えた、粒状体検出装置。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、たとえば液晶を駆動するためのスイッチング素子として薄膜トランジスター(TFT:Thin Film Transistor)を備える液晶パネルなどのガラス基板間の間隙を形成するのに用いるスペーサの計数や凝集検査、ガラス基板上の異物を検出する異物検査を行なう粒状体検出装置およびこれに使用する照明装置に関する。

## 【0002】

【従来の技術】 (液晶パネルの製造工程) 液晶パネルは、液晶を駆動するための電極を備え、一定の間隔で平行に配置された一対のガラス基板とその一対のガラス基板の間に形成された液晶層とを備える。この液晶パネルは、次に示すような方法によって製造される。

【0003】 一対のガラス基板のうち、一方のガラス基板に熱硬化型のシール剤を塗布し、他方のガラス基板に基板間隔を均一にするためのスペーサを散布する。ここでいうスペーサは、通常、球径の均一なプラスチックビーズが用いられる。この後、この一対のガラス基板の位置合わせを行い、仮止めを行う。

【0004】 このガラス基板をプレスして基板間隔がスペーサ径と同じになるようになる。加熱することでシール剤を硬化させ貼合せを行う。貼り合わせた基板を所望の液晶パネルの大きさに切断する。真空チャンバ内において、ガラス基板間の間隙に液晶を注入する。液晶注入終了後、注入口に紫外線硬化型の封止剤を塗布して紫外

線照射し、注入口の封止を行う。

【0005】 以上的方法により、一対のガラス基板間の間隙を液晶によって充填した液晶パネルを製造することができる。

【0006】 (スペーサ) 上述の液晶パネルの製造工程の中で、液晶パネルのガラス基板間の間隙を均一に形成するために配置されるスペーサは、散布される個数や分布が重要となる。スペーサの数が少なすぎると、ガラス基板間の間隙が狭くなり、所定の間隙を形成できず、表示品位が劣化する。また、スペーサの数が多すぎると、スペーサ周辺でのいわゆる光りぬけが多くなる。「光りぬけ」とは、スペーサ周辺の液晶が配向乱れを起こしたり、スペーサが透明である場合にスペーサ自体が光を透過してしまったりすることによって、光を遮断することで黒表示をしようとしたときにその箇所だけ光が透過してしまい正しく黒表示にならない現象をいう。このような光りぬけの発生は、コントラストの低下をもたらし、表示品位が劣化する。

【0007】 このため、スペーサを散布した後にスペーサの個数や分布を測定して、スペーサの散布状態を監視することが必要となる。スペーサの計数を行う方法として次のような方法が用いられる。図6に示すようなリングライト41を用いた反射照明によってスペーサに照明光を当ててスペーサから散乱光を発生させる。スペーサからの散乱光をCCDカメラを用いて取り込む。取込んだ画像に対して2値化を行うことでスペーサと背景とを分離し、スペーサの計数を行う。

【0008】 スペーサが散布されているガラス基板がTFTを形成したガラス基板である場合、ゲートラインやソースラインといった配線パターンは、T a、A 1などといった、高い反射率を有する金属膜によって形成されている。配線パターンの凹凸が大きい場合、リングライトによる照明では配線パターンのエッジも反射光を発生する。このため、ガラス基板に形成された配線パターンとスペーサとの2値化による分離が困難となる。

【0009】 これに対して、特開平8-148025号公報では、ガラス基板に形成された配線パターンからの反射光を低減するため、図6に示す構造において、リングライトの照明部分のうち、ゲートラインとソースラインの配線パターンに対して直交して照射する部分を遮光するという技術が提案されている。これにより、配線パターンからの反射光を低減でき、スペーサと背景との2値化による分離が容易となる。

## 【0010】

【発明が解決しようとする課題】 同公報において提案された技術では、スペーサの計数を行なう際には、測定対象である基板を移動させながら任意の測定箇所における計数を行なう。その実現のため、同公報において提案された照明装置においては、リングライト41は、ガラス基板6を移動させてもガラス基板6と接触しない程度の

クリアランスだけ浮かせて設置される。

【0011】このとき、図6に示したリングライト41の光ファイバ投光口42は、リングライト41の底面よりも若干上の位置に配置されている。光ファイバ投光口42より下の部分を、プレート43と呼ぶこととすると、光ファイバ投光口42から光ができるだけ水平に近づけるには、プレート43はできるだけ薄くすることが望ましいが、プレート43をあまり薄くすると、リングライト41の強度を保つことができなくなる。しかし、プレート43を厚くすると、光ファイバ投光口42から光は測定箇所に対して斜め上方から入射することとなってしまう。

【0012】したがって、測定箇所における配線パターンの凹凸が大きい場合には、リングライトの非遮光部分からの照射光が、配線パターン部分に対して略垂直に照射される箇所において、上方のCCDカメラに向かう向きの反射光を多量に発生させることとなる。

【0013】あるいは、プレート43が多少厚くても、リングライト41の直径を大きくすることで、測定箇所への光の入射を水平に近づけることも可能ではあるが、その場合、光ファイバ投光口42から測定箇所までの距離が長くなり、照度が低下してしまう。

【0014】結局、この照明装置によれば、ゲートライン、ソースラインの配線パターンでの反射光は低減されるが、リングライトの遮光しない部分からの照射光が、配線パターンに垂直に照射される箇所において、反射光を発生させる場合があるため、スペーサと背景との2値化による分離が困難となるという問題点があった。

【0015】本発明は、上述の課題を解決するためになされたものであり、液晶パネルのガラス基板に形成された配線パターンからの反射光を低減し、スペーサからの散乱光と、配線パターンからの反射光とのコントラストを大きくすることによって、スペーサと背景との2値化による分離を容易にする、照明装置および粒状体検出装置を提供することを目的とする。

【0016】

【課題を解決するための手段】上記目的を達成するため、本発明に基づく照明装置においては、上面に直交して設けられたマトリックス状の線状パターンを有する基板上面の所望の検出位置に存在する粒状体の検出を行なうために、上記所望の検出位置に対して、上方から見て上記線状パターンのいずれの直線部分に対しても略垂直でない少なくとも2方向であって、基板上面となす角度が3°以下となるような照射方向で、光を照射する。この構成を採用することにより、線状パターンの各構成要素の直線部分に対して、上方から見て光が略垂直に照射することはなく、また、基板上面となす角度が、実験によても良好な結果が得られた3°以下であるので、これらの各構成要素のエッジなどから上方へ向かう反射光を低減することができる。

【0017】上記発明において好ましくは、光供給手段と、上記光供給手段からの光を上記照射方向に反射するように保持されたミラーとを備える。この構成を採用することにより、ミラーの下端で反射させることができため、基板にきわめて近接した位置で反射をさせることができ、その結果、基板上面となす角度が3°以下となるような照射方向で、十分な照度で光を照射することが、確実かつ容易に可能となる。

【0018】上記発明において好ましくは、上記光供給手段および上記ミラーを保持し、下面を有するホルダを備え、上記下面には、上記照射方向に進行する光を妨げないように凹部が設けられている。

【0019】上記構成を採用することにより、ホルダの存在により、光供給手段とミラーの位置関係がより確実に固定され、照明装置の取り扱いが容易となる。また、ホルダの下面には凹部があるため、ミラーから反射した光が、拡散したり、進行方向がずれたりしても、一定の範囲内であれば、ホルダの下面で妨げられることなく、測定箇所に到達することができ、十分な照度で照射することができる。さらに、凹部の深さを一定以上深くしないことによって、測定箇所に対して基板上面となす角度が所望の角度より大きくなるような照射方向で向かう光を遮断する役割を持たせることもできる。

【0020】上記発明において好ましくは、上記光供給手段から出た光を集光し、上記ミラーに導くレンズを備える。この構成を採用することにより、光供給手段から供給された光を効率良くミラーで反射することができる。また、集光された光が反射して、測定箇所に向かうため、測定箇所の照度を上げることができる。

【0021】本発明に基づく粒状体検出装置においては、上述の照明装置を含む照明手段と、上記照明手段で照射した上記所望の測定箇所からの反射光を検出する光検出手段と、上記光検出手段で検出した結果から、上記粒状体に起因する情報を分離抽出する抽出手段とを備える。

【0022】上記構成を採用することにより、照射された光のうち、線状パターンで反射して光検出手段に向かう成分は少なくなる一方、粒状体で散乱する光は光検出手段に向かうため、光検出手段で検出した画像は、粒状体の像と背景の像とのコントラストが大きくなっており、2値化して粒状体に起因するものと背景に起因するものとを分離することが容易となる。さらに、この粒状体検出装置は、抽出手段を備えているため、粒状体の計数や分布把握を容易に高精度で行なうことができる。

【0023】

【発明の実施の形態】(実施の形態1)

(構成) 図1に、本実施の形態における照明装置を示す。この照明装置は、光源(図示省略)からの光を照射する光供給手段であるライトガイド1と、ライトガイド1からの照射光をガラス基板6に対して反射するミラー

2と、ライトガイド1とミラー2を保持するホルダ3を備えている。測定対象であるガラス基板6を水平面に置き、この照明装置をガラス基板6の上方に設置して測定を行なうものとしたとき、ライトガイド1は、鉛直上方から鉛直下方に向けて光を出射するように固定されており、ミラー2は、その反射面の水平面となす角度が46°となるようにホルダ3に固定されている。ミラー2の反射面が水平面となす角度はここでは46°としたが、このようにしたのは、図2に示すように、ミラー2が鉛直上方のライトガイド1から照射される光を反射したときに、反射光が、水平面との間でなす角度が2°となる照射方向で、測定箇所に向かうようにするためである。ホルダ3が、下面を有しない構造である場合は、ホルダ3の下面が光の進行を妨げるおそれがないが、ホルダ3は強度を維持するためには、下面を有する構造である場合が考えられ、その場合、その下面には、測定箇所に向かって進行する光を妨げないように凹部が設けられていることが望ましい。図1の構造においては、そのような凹部として、溝4が設けられている。なお、溝4の深さを一定以上深くしないことによって、測定箇所に対して基板上面となす角度が所望の角度より大きくなるような照射方向に向かう光を遮断する役割を持たせることもできる。

【0024】図3に、この照明装置でガラス基板6についての測定を行なう状態を上方から見たところを示す。ガラス基板6は、その上面に直交して設けられたマトリックス状の線状パターンとして、ゲートライン11とソースライン12とが直交する配線パターンを有し、そのマトリックス状に区切られた各区画の隅にはTFT素子13を有する。各区画内の透明電極14の中央を測定箇所として以下、説明する。

【0025】図3を参照して、測定箇所に対する光の照射方向について注目すると、光は、線状パターンの方向から約45°回転させた方向の、直交する4方向からの光5として照射されるように、ライトガイド1、ミラー2および溝4は配置されている。

【0026】(作用・効果) ライトガイド1から照射された光はミラー2で反射し、溝4を通過して、光5として測定箇所に向かう。光5は、上述の直交する4方向から、ガラス基板6上面(水平面)となす角度が2°となるような照射方向で、照射される。光5は、スペーサ7に当たって散乱する。この照明装置の上方に何らかの光検出手段を設置すれば、スペーサ7からの散乱光を検出し、検査のための情報として利用することができる。

【0027】一方、光5のガラス基板6の上面とのなす角度が2°と小さいため、ガラス基板6に形成された配線パターンに起因する反射光は、上方に反射する成分を少なく抑えることができ、上方に光検出手段を設置したときに検出される光は、スペーサ7に起因する散乱光が支配的となるようにすることができる。

【0028】4方向からの光5は、上方から見てゲートライン11およびソースライン12のいずれの直線部分に対しても約45°回転させた方向から照射されているため、ゲートライン11、ソースライン12、TFT素子13などの直線部分に光が略垂直に照射することなく、これらの配線パターンなどのエッジなどからの反射光で上方に向かう成分は低減できる。

【0029】(実施の形態2)

(構成) 図4に、本実施の形態における照明装置を示す。基本的には、実施の形態1で説明したもの(図1、図3参照)と同じであるが、光供給手段としてのライトガイド21から出た光を集光し、ミラー22に導くためのレンズとして集光レンズ26を備える。集光レンズ26はライトガイド21とともに集光レンズホルダ27に保持されている。

【0030】(作用・効果) このように集光レンズ26を設けることで、ライトガイド21から供給された光を効率良くミラー22で反射することができる。また、集光された光が反射して、光25として測定箇所に向かうため、測定箇所の照度を上げることができる。

【0031】なお、上記各実施の形態では、ミラー2の反射面が水平面となす角度は46°とし、反射光が水平面との間でなす角度が2°となるようにしたが、これらの組合せは、これら以外の値であってもよい。角度を何通りか変えて実験を行なったところ、反射光が水平面との間でなす角度が3°より大きい場合には、上方に光検出手段を配置したときに検出される配線パターンからの反射光は、画像の2値化によってスペーサと配線パターンとの分離が困難なほどに多くなったが、3°以下となるようにすれば、配線パターンからの反射光は著しく少なくすることができ、分離が容易となった。よって、反射光が水平面との間でなす角度は、3°以下であることが望ましい。

【0032】これは、スペーサは、基板面の上に大きく突出する形で載っているのに対し、配線パターンは基板面からの高さがスペーサに比べて低いため、水平に一定以上近い角度で光を当てたときには、スペーサには光が当たって散乱するものの、配線パターンに当たる光が著しく小さくなることによる。

【0033】なお、特開平8-148025号公報に開示された技術でも、「ほぼ水平方向に」照射する旨の記載があるが、同公報に開示された照明装置では、光ファイバ投光口を基板近くに設ける必要があり、かつ光ファイバ投光口の下側のプレートによってリングライト自体の強度も維持しなければならないという制約から、照射方向と水平面とのなす角度は、現実には3°より大きな値となっていた。すなわち、「ほぼ水平方向に」とは、実質的に3°より大きな角度の中で選択された、比較的の水平方向に近い照射方向にすぎなかった。これに対して、本発明は、実験によって、3°以下である場合が、

特に好ましいことを見出し、また一方、上記制約を解消することによって、実際に3°以下の方向での照射が可能な照明装置を提供したものである。

【0034】なお、上記各実施の形態では、上方から見て、光は、線状パターンの方向から約45°回転させた方向の、直交する4方向から照射されるように、構成したが、この回転角度は約45°に限られるものではなく、線状パターンのいずれの直線部分に対しても略垂直でない方向であれば、上から見たときの線状パターンに対する角度に関しては、他の角度からの照射であってもよい。また、直交する4方向からの照射であることは、測定箇所の照度を上げ、スペーサにおける散乱の向きのバランスを整え、スペーサからの散乱光を増すためには特に好ましいが、必須ではなく、少なくとも2方向からの照射であってもよい。

#### 【0035】(実施の形態3)

(構成) 図5に、本実施の形態における粒状体検出装置を示す。この粒状体検出装置は、基板上面の所望の検出位置に存在する粒状体の検出を行なうためのものであって、照明手段として、実施の形態1または2に述べた照明装置32を備える。さらに、この粒状体検出装置は、照明装置32で照射した所望の測定箇所からの反射光を検出する光検出手段として、CCDカメラ34を備える。さらに、この粒状体検出装置は、CCDカメラ34で検出した結果から、粒状体に起因する情報を分離抽出する抽出手段として、画像処理装置35を備える。

【0036】照明装置32のライトガイド31は、光源装置33から光の供給を受けている。ライトガイド31が、複数ある場合であっても接続を分岐させることで1台の光源装置33でまかなうことができる。光源装置33は、たとえばハロゲンランプを用いることができるが、これに限らず、同様の光を発するものであればよい。照明装置32は、スペーサ7の散布されたガラス基板6を移動させても接触しないように一定のクリアランスだけガラス基板6から浮かせて保持されている。

【0037】(作用・効果) スペーサの検出は、以下に述べる手順で行なわれる。スペーサ7が散布されたガラス基板6の所望の測定箇所がCCDカメラ34の真下に来るよう、ガラス基板6を移動させる。照明装置32によって測定箇所に対する照射を行なう。

【0038】照明装置32からの照射光は、配線パターンに対して、実施の形態1で述べたような直交する4方向から、ガラス基板6上面(水平面)となす角度が2°となるような照射方向で、照射される。その結果、実施の形態1で述べたように、照射された光は、スペーサ7に当たって散乱するものの、配線パターンなどのエッジなどからの反射光で上方のCCDカメラ34に向かって反射する成分は低減することができる。すなわち、CC

Dカメラ34に検出される光としては、スペーサ7からの散乱光が支配的となる。したがって、CCDカメラ34で取込んだ画像を画像処理装置35で処理する際に、スペーサ7の像と背景の像とのコントラストが大きくなっている、2値化してスペーサ7に起因するものと背景に起因するものとを分離することが容易となる。その結果、スペーサの検出精度が上がり、スペーサの計数や分布把握を高精度に行なうことができるようになる。

【0039】なお、上記各実施の形態では、スペーサを検出対象としてきたが、スペーサの凝集を検出対象としてもよく、ガラス基板上のごみやほこりなどの異物を検出対象としてもよい。すなわち、スペーサ以外の粒状体の検出に用いることもできる。

【0040】なお、今回開示した上記実施の形態はすべての点で例示であって制限的なものではない。本発明の範囲は上記した説明ではなくて特許請求の範囲によって示され、特許請求の範囲と均等の意味および範囲内でのすべての変更を含むものである。

【0041】  
20 【発明の効果】本発明によれば、光をミラーで反射することによって、基板上面となす角度が3°以下となるような照射方向で、光を照射するため、線状パターンから上方への反射光を低減することができる。そのため、上方に設けた光検出手段で検出した画像は、粒状体の像と背景の像とのコントラストが大きくなる。したがって、2値化して粒状体に起因するものと背景に起因するものとを分離することが容易となる。

【図面の簡単な説明】  
30 【図1】 本発明に基づく実施の形態1における照明装置の断面図である。

【図2】 本発明に基づく実施の形態1における光路についての説明図である。

【図3】 本発明に基づく実施の形態1における照明装置の平面図である。

【図4】 本発明に基づく実施の形態2における照明装置の断面図である。

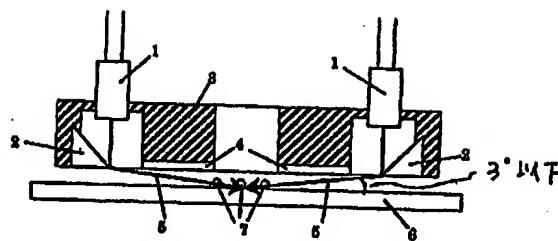
【図5】 本発明に基づく実施の形態3における粒状体検出装置の側面図である。

【図6】 従来技術に基づく照明装置の斜視図である。

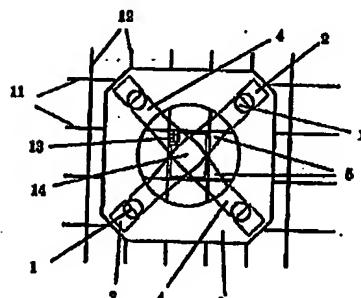
#### 【符号の説明】

1, 21, 31 ライトガイド、2, 22 ミラー、  
3, 23 ホルダ、4, 24 溝、5, 25 光、6  
ガラス基板、7 スペーサ、11 ゲートライン、12  
ソースライン、13 TFT素子、14 透明電極、  
26 集光レンズ、27 集光レンズホルダ、32 照明装置、33 光源装置、34 CCDカメラ、35  
画像処理装置、41 リングライト、42 光ファイバ  
投光口、43 プレート。

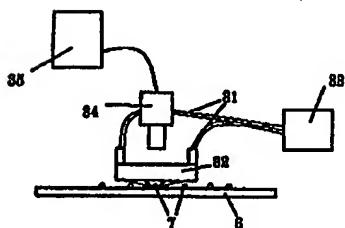
【図1】



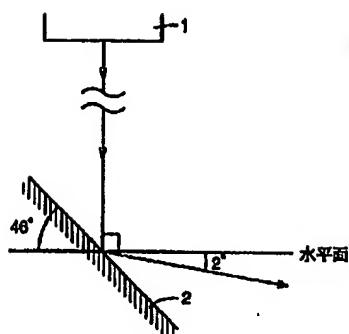
【図3】



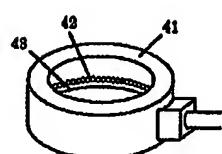
【図5】



【図2】



【図6】



【図4】

